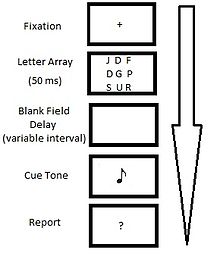
**Performance of memory for colors and it’s behavior**

**with harmonious sets of colors**

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**Introduction**

 Memorization of colors is not something new. It has been implemented in many experiments, with many different theories and in many different fields. The intention behind this experiment is implementation of two theories. A theory called iconic memory and a theory of color relations.

Iconic memory is use of visual short-term memory to capture a whole picture in a brief moment without understanding the details of it. Yet, the information is stored in the brain and can be used when needed. One of the experiments that plays a huge role in the creation of iconic memory is George Sperling’s experiment, where participants were given a display of letters for 50-milliseconds. After displaying the letters (3 rows with 3 letters each), participants were asked to write down the letters of a certain row depending on the “beep” sound. Surprisingly, participants were able to write the letters from asked row even though they couldn’t remember all the letters. It shows that brain stored the information and used it when needed.

Square

Description automatically generated with medium confidenceColor relations is experiment by Noah Sulman and Thomas Sanocki, in which they tested whether the harmony of colors affect the ability to memorize the pattern. In their experiment, participants were given a pattern of colors. First trial consisted of distinct inharmonious colors, meaning that colors were on different hue. Second trial consisted of colors which are on the same hue but with different saturation, brightness, they were harmonious. Results showed that harmonious colors were easier to remember. Based on participants’ feedback, harmonious colors were more appealing, thus easier to remember.

The main question is, does Noah Sulman and Thomas Sanocki’s experiment affect the iconic memory?

**Methods**

Diagram

Description automatically generated The design of the experiment is borrowed from Brandon Forys’ “change detection task” <https://gitlab.pavlovia.org/bforys/change-detection-task>. In Brandon’s experiment, colors are always inharmonious. Since, testing out harmonious colors are essential, the experiment design is a little bit changed: there are periods where only harmonious colors are used.

There are 4 main steps in the experiment:

1. Fixation

Participants are asked to fixate their eyes on the cross at the center of the screen.

1. Encoding

A set of colors appear on the screen for 0.5s. The number of squares, the position, the colors used are random.

1. Masking

After encoding, several striped squares appear on the screen for 0.5s. Each square is striped with random colors. The positions and number of squares are also random

1. Cue

One square appears. Participants are asked to press ‘A’ if cue color was present in the encoding phase, or ‘L’ if cue color was not present in the encoding phase.

A picture containing icon

Description automatically generated

These 4 steps are considered as 1 trial. In one go, there are 70 trials. First 30 trials display harmonious colors, 30-40 trials display harmonious red colors, 40-50 trials display harmonious green colors, 50-60 trails display harmonious blue, and the last 10, 60-70 display again inharmonious colors. The participant’s were not warned about harmonious color switches. The only thing that was informed is that, color may not be always distinct, meaning that some colors may have it’s dark or bright versions.

Text, letter

Description automatically generated Although pavlovia credits were provided, due to problems with syncing psychopy builder and pavlovia, the experiment couldn’t be hosted on the website. With the approval of professor and TA, the experiment was run locally on laptop. All the participants’ names and signs were recorded:

Demography:

Countries – Kazakhstan (7, 46.6%), Kyrgyzstan (6, 40%), Mongolia (1, 6.7%), Azerbaijan (1, 6.7%).

Age – Freshman (2, 13%), Junior (7, 46.6%), Senior (5, 33%), Graduate sophomore (1, 6.7%).

Gender – Male (10, 66%), Female (5, 33%)

All the data was directly recorded into a “data” folder of the experiment file.

Each time a participant finished the experiment, one csv file was generated with 150 columns and 71 rows. In csv file information such as which colors were displayed, positions of squares, number of squares, key response of participants’, correct answers etc are stored.

A picture containing table

Description automatically generated\*only part of the data table

**Results**

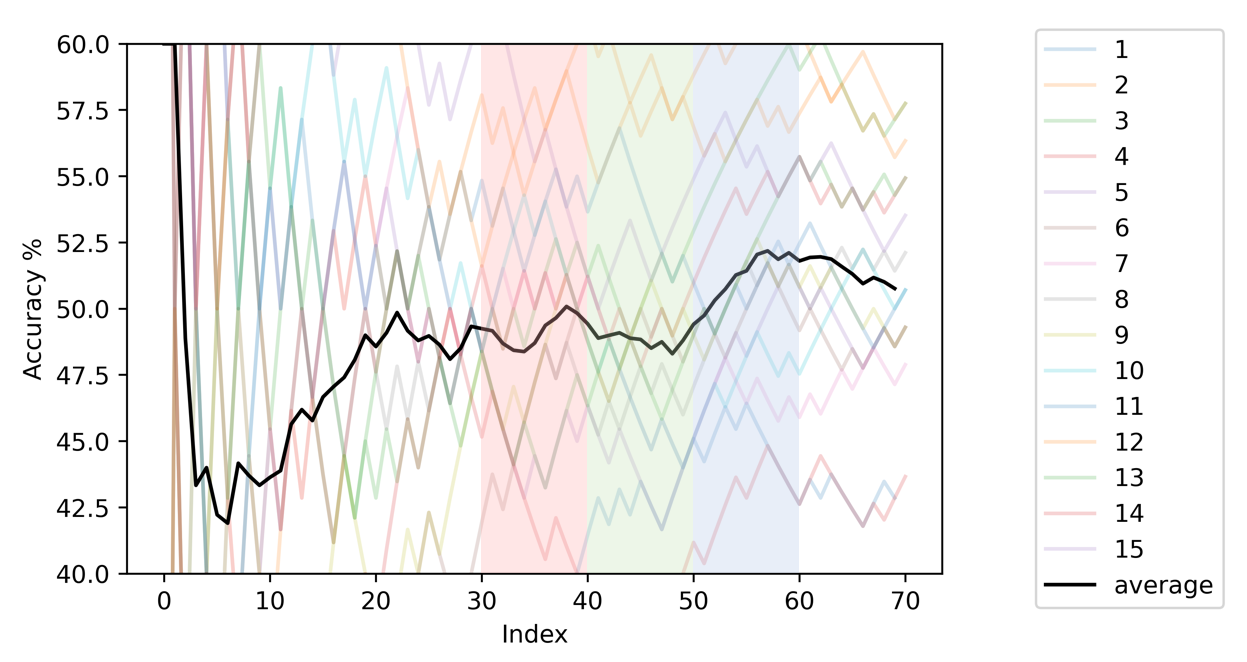
With the data available, more information can be found. The csv files were manipulated in google colaboratory. Pandas library was used to manipulate the dataframes, numpy to make mathematical operations and matplotlib to plot graphs.

Chart, histogram

Description automatically generatedI only had the response that participant gave and the correct response, so new column “accuracy” was created. Accuracy column showed whether the participant guessed correct or not (1 for correct, 0 for incorrect). To calculate accuracy percentage, new column was created that calculated (correct responses/all responses until current trial) accuracy% to the moment of trial. For example, at the first trial participant gave wrong response – his accuracy% is 0%. On the second trial he gave correct response – his accuracy% is 50% and so on. Combining all 15 dataframes, average accuracy% was calculated.

\*accuracy% for 15 participants throughout the experiment.

Chart

Description automatically generated

Average accuracy% of 15% participants. The same graph but zoomed in, from 40 to 60 on y.

X axis on these graphs is number of trials, while y axis is accuracy %. Red, green, and blue zones correspond to the number of trials where harmonious colors started being displayed.

It was expected that when entering the red zone of harmonious colors, accuracy should have dropped. Same for when leaving the harmonious blue zone. Participants were expected to be surprised by the switch which would have dropped their accuracy%.

The only expectation that was met is an increase in accuracy% during the harmonious zones, which is seen on the graph.

Since I was present every time a participant took the experiment, I knew the answer why the expectations were not met. Let’s see reaction times.

Chart, histogram

Description automatically generatedChart, histogram

Description automatically generated

Average reaction time graph Same graph, zoomed in, 0.5 – 2.5 on y.

Chart, histogram

Description automatically generatedIf we look at the zoomed in graph of average reaction time, huge spike when entering red zone can be seen. Participants took twice as more time to think before answering to harmonious red color trial. Another spike is seen in red zone a second time, which means it took some time to get used to harmonious colors. After which, reaction time decreased to its normal 1s~ range.

\*merged graph of accuracy% and reaction time

Third spike is spotted right when leaving the harmonious color trials, trial 60. Participants again took more time to answer to inharmonious color trials comeback.

This is the reason why accuracy was not decreased at two crucial points: trial 30, and trial 60: because participants took more time to answer.

**Conclusion**

This experiment tested how memory for colors behave when dealing with harmonious colors or inharmonious colors. Only some expectations were met however, decent reasons were provided for those that were not.

Noah Sulman and Thomas Sanocki’s experiment on color relations is verified looking at the accuracy growth in harmonious color trials. Taking into consideration that after every trial, contribution of correct or incorrect answer becomes less and less. So in order to get that growth during the harmonious sets, continuous correct answers are crucial.

It takes time for a brain to get into flow of memorizing with VSTM (iconic memory).

It takes time to switch from memorizing inharmonious colors to harmonious colors and vice versa.

Switch within harmonious sets of different colors does not take much time.

With a little more time to react, harmonious colors are easier to remember based on accuracy% and participants’ feedback.

Participants reported that harmonious colors were actually easier to remember. On the inharmonious trials, black color was the easiest.

If we look at reaction time graph we can see that one participant (purple) was answering very fast, almost 0 seconds, which means that this participant didn’t care about the experiment… Seems like I forced him to do the experiment and he didn’t want to…

**References**

Sensation and Perception course (Iconic memory)

<https://www.sciencedirect.com/science/article/pii/S1364661313001265?casa_token=vwewNHNogJcAAAAA:XsRcxMoJRgRYp1YAkI6ODa3fna6d0MHiH9hijsT-9vQJfATYlrI_kGwgsMYfV9hYEl6j3o6bnA6u>

<https://gitlab.pavlovia.org/bforys/change-detection-task>

<http://shell.cas.usf.edu/~sanocki/SanockiSulman2011.pdf>